Available online at www.sciencedirect.com
ScienceDirect
Procedia - Social and Behavioral Sciences 214 (2015) 359 – 367
Procedia Social and Behavioral Sciences

Worldwide trends in the development of education and academic research, 15 - 18 June 2015

Changing Role of the University in Innovation Development: New Challenges for Russian Regions

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Abstract

The need of Russia's transition to a knowledge economy, knowledge-intensive production, high technology and intensive innovation requires transformation of the higher education system and the formation of entrepreneurial universities. The analysis of the Russia's higher education system revealed that the development of universities is contrary to the global educational trends and to the social and economic priorities of Russia. High efficiency of cluster policy in the leading countries of the world has led to the advancement of initiatives for the innovative regional cluster development in the region. The results of econometric analysis indicate that the presence of a strong university as an "anchor" increases the influence of innovation factors on the regions' socio-economic development. Formation of innovation clusters in the regions of Russia requires the emergence of "strong" universities that engage applied and fundamental research studies, work closely with the industry and implement knowledge into practice.

Peer-review under responsibility of: Bulgarian Comparative Education Society (BCES), Sofia, Bulgaria & International Research Center (IRC) 'Scientific Cooperation', Rostov-on-Don, Russia.

Keywords: entrepreneurial university; innovative development; regional economy; innovative regional cluster

1. Introduction

Many years of experience in the Tyumen Region's development were held in the logic of industrial development, the basis of which was laid mainly by vertical relations of the federal center and by the major oil companies developing fields in the region. All other areas of regional development, whether it it science or

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Peer-review under responsibility of: Bulgarian Comparative Education Society (BCES), Sofia, Bulgaria & International Research Center (IRC) 'Scientific Cooperation', Rostov-on-Don, Russia.
doi:10.1016/j.sbspro.2015.11.659

education, were taking a subordinate position. This model of the regional development organization has undergone some changes, but the basis is used in the present time. But the history of the developed countries' economic development clearly draws only one way to success – it is public awareness of the priority of innovation development, improvement of the education's quality, high level of science's funding, minimizing the administrative barriers to doing business, providing an efficient process of technology transfer and commercialization, "friendliness" of the legal financial and tax systems to innovations. The world experience shows that the establishment and maintenance of equal partnership relations between the three main actors in innovation development: government, business and universities serve as the institutional framework of building an effective innovation system. The new configuration of society which ensures the integrity of the innovation process is most fully represented in the model of G. Etzkovitz's "triple helix" (Etzkovitz, 2000). It combines innovative efforts of universities, business and government with the central role of universities. Moreover, the leading role in the model of the "triple helix" belongs to the entrepreneurial university. In the industrial society university prepares specialists, carries out fundamental and applied researches, but very rarely is involved in the processes of technology transfer and commercialization, the launch of small innovative firms. Post-industrial society imposes radically different demands on universities, they become the centers of generating technologies and new forms of business, reserving, of course, research and training. As a result, the university is transformed from the classical into the entrepreneurial. Of course, it retains the academic component, but it focuses on the development of the entrepreneurship beginning in the students. The entrepreneurial university becomes a place of organizing the continuous flow of knowledge generation and new forms of business, their transformation into innovation.

2. Methodology

As part of the innovation system's research, the determining certain key elements of the innovation system and the analysis of the knowledge circulation forms within the system play the central role. Summarizing the researches, that were conducted in the recent years, the elements, which are in the focus of the most authors, can be determined (Edquist, 1997; Lundvall, 1992; Kumaresan & Miyazaki, 1999; Nelson, 1993; OECD, 1999). Firstly, it is a set of institutions that are involved in the production, transmission and usage of knowledge, including government, enterprises, universities and research institutes. Secondly, these are all the other elements that affect the innovation process: the context created by macroeconomic policies, the system of education and training, the system of financing innovations, communications and interaction with the international environment, the mechanism of innovation development, reflecting the system of relationships between these elements.

Almost all of the works, devoted to the innovation system, focus on the fact that the flows of technology and information among people, enterprises and institutions play a key role in the innovation process (Etzkowitz & Leydesdorff, 1995; Etzkowitz & Leydesdorff, 1997). Technological development is the result of a complex set of relationships between the system participants - companies, universities and public research institutions. Ongoing systemic transformation of the economy and society, transition to a post-industrial society, economy of knowledge, increase the value of the educational system to the society and economy (Etzkowitz, 2003; Mowery & Sampat, 2004).

University's opportunities for the region's development are considered in the following areas: universities are the main base for fundamental scientific research, creating conditions for regions' technological, socio-economic development in most countries. University studies are an important part of the scientific personnel's training, scientific and pedagogical potential of the region's accumulation. University often becomes a "pole of attraction" of knowledge-based industries' enterprises in its region (Armstrong & Taylor, 2000; Slaughter & Leslie, 1997).

Modern universities are expanding goals and enriching features. Universities are not limited to the task of ensuring the highly qualified personnel to the economy, they are stepping up the activities in the field of research and development, ensuring the innovative development, becoming the regional centers of entrepreneurial activity (Armstrong & Taylor, 2000; Slaughter & Leslie, 1997; Clark, 1998). Thus, a concept of the entrepreneurial university is being formed.

The concept of "entrepreneurial university" is used in a variety of studies published since the mid-1990s. However, a clear definition of this concept is still missing. B. Clark (1998) considers that the main feature of the entrepreneurial university is the lack of fear to commercialize the generation and dissemination of knowledge.

According to him, members of the university do not see the danger in the commercialization for the academic traditions and the quality of education. According to the approach of G.N. Konstantinov & S.R. Filonovich (2007), an entrepreneurial university is a higher educational institution, which is systematically making efforts to overcome the limitations in three areas - the generation of knowledge, teaching and transforming knowledge into practice - by initiating new activities, transformation of the internal environment and modification of the interaction with the environment.

Analysis of the foreign experts' works on the problems of the region' innovative development leads to the conclusion that innovation policy of the world countries is marked with the general trends. The general trend of the world's innovation policy is applied with cluster approach in its formation. Government concentrates its efforts on supporting existing clusters and the creation of new networks of companies. The main feature of such cluster's functioning is a concentration of innovation processes' all participants around the core, which is a university or research complex at the present stage. The universities' inclusion in the region's clusters enables competitive advantages to the region: investors can make investments both into the real economy and educational and research processes (Armstrong & Taylor, 2000; Slaughter & Leslie, 1997).

The main purpose of the article is to determine the role of the university in Russian region's innovative development. The purpose is specified by the following tasks: to analyze Russian higher education system in terms of global "vectors" of development; to assess the degree of influence of the universities' quality on the areas' of innovative development; to evaluate the innovative factors' influence on the regions' social and economic development; to determine the focus areas of formation of entrepreneurial university. Scientific novelty of the research is the following: the particularity of the higher education system in Russia in terms of global "vectors" of development has been systematized; two groups of regions that are areas of pilot clusters' placement have been identified to assess the degree of influence of the universities' quality on the areas' innovative development; an evaluation of the innovative factors influencing the detected regions' social and economic development has been held highlighting regions with strong "anchor" institutions of higher education.

3. Analysis

The last decade of the higher education sector's development was marked by intensive and large-scale changes caused by three main vectors. Firstly, it is the need for the countries' socio-economic development that was associated with the formation of a new technological structure of the economy. Secondly, it is strengthening of integration processes in the system of higher education and formation of the global educational space. Thirdly, it is the increase in the average age of professional competence's formation and the spread of the 'continuous' learning concept.

For the Russian system of higher education (SHE) the development of these trends has coincided with unprecedented scale internal reforms affecting all the aspects of the educational process - its structure, functions, features and learning technology. Liberalization of the higher education system in 1990s has led to a significant expansion of the industry, so that during the period from 1990 to 2008 (Table. 1) the number of universities has increased 2.2 times, the number of students increased 2.7 times, the number of professors teaching staff (PTS) - 1.8 times (Federal'naja sluzhba gosudarstvennoj statistiki, 2014). During the "educational" euphoria the share of employment with tertiary education in total employment increased by 2 times. However, the intense dynamics could not affect the quality of educational services. The popularization of higher education and the reduction of the requirements, coupled with the universities' pursuit of profit have led to the fact that the educational process in Russian universities bought frankly imitative nature. Commercial landmarks of universities are very dangerous, since they entail the destruction of academic traditions (OECD, 2014). As a result, the country received a "diploma mill" in socio-economic and legal areas and reducing the release of physical and mathematical, engineering and natural scientists.

According to the Education at a Glance report, Russia is noticeably inferior to OECD countries by the level of spending on higher education (Expenditure on tertiary education as a percentage of GDP) in relation to GDP. The figure in Russia is 1.4%, for comparison, in Canada, it is 2.8%, in the United States it is 2.8%, in Finland it is 1,9%, in the Netherlands it is 1.8%, in Israel, Norway and Sweden it is 1.7%. In the OECD countries it is 1.6 % on average. The improvement in financing of Russian universities, that has been marked in recent years, has led to an increase in expenditures for higher education in relation to GDP by 75% (from 0.8% in 2008). The expenses for 1 student in Russia in 2011 amounted tUS $ 7424. It is lower than in all of the OECD countries, and significantly lower than in the developed countries. The expenses for 1 student in the US were equal to US $ 26,021, in Switzerland to US $ 22882, in Sweden to US $ 20818, in Denmark to US $ 21254, in the OECD countries on average to US $ 13958. In addition, there was a decrease of expenditures by 9% in Russia in 2005-2011, against the backdrop of growth in the OECD countries by 10 %. The analysis of the cost for higher education structure says that the share of private spending in Russia is comparable to the OECD counties (0,2%), but the share of public sector spending in Russia is lower. It is 1.4% versus 1.6% on average for the compared group of countries.

Table 1. Key indicators of higher education in Russia in 1990-2013

Indicators	1990	2000	2005	2008	2010	2012	2013
The number of higher educational establishments, units.	514	965	1068	1134	1115	1046	996
The number of students in higher educational institutions, thous. pers.	2824,5	4741,4	7064,6	7513,1	7049,8	6075,4	5646,7
The number of students in higher educational institutions, per 10,000 people population.	190	327	493	526	493	424	393
The number of teaching staff within the higher educational institutions (regular staff), thous. people.	219,7	279,6	358,8	404,6	356,8	342,0	319,3
The share of employed with higher education in the economy,%	16,1*	24,7	26,2	27,9	29,1	30,4	31,7

* the data of 1992

The analysis of higher education system in Russia in terms of global "vectors" of development leads to the following conclusions:

1. The need for a speedy overcoming of excessive dependence of Russia on the export of raw materials with access to the knowledge economy, high-tech industries, high technology and innovation changes demands the system of higher education. World experience in creating high-tech clusters is based primarily on fundamental research of leading entrepreneurial universities. Analysis of the levels of spending on R&D by the institutions of higher education in Russia and OECD countries demonstrates the "weakness" of the Russian universities' position in the development of the research sector. Research and development are not the strategic priorities of higher education institutions in Russia, R&D expenditures in total expenditures in 2011 were amounted of 7% (the average of OECD counties is 32%). In the modern world the system of higher education is based on the close integration of education, research and new forms of entrepreneurship. Russian universities are leading the way of implementation of the traditional functions, the educational process is based on the curriculum, which is a configuration of the training programs that are served with lectures and seminars (Fig. 1).

2. The intensification of globalization processes formed a tendency to create a single educational space as the most effective form of implementation of educational and research processes. Academic mobility is one of the indicators of education's involvement into the integration processes (International student mobility and foreign students in tertiary education). The share of foreign students in the total number of students in higher education programs in Russia in 2012 amounted 2%, which corresponds to the level of Slovenia and Estonia, but much inferior to the level of developed countries, in particular, the figure in the UK is 17%, in Switzerland is 16%, in the OECD countries is 8% on average. In the ranking of national higher education systems that is maintained by the Melbourne Institute of Applied Economic and Social Research (University of Melbourne), Russia took the 35th place in 2014 that is behind China, Chile, Serbia and Hungary. The worst position is marked on the index of connectivity, which once again underlines the weak link of universities with the business practices, the lack of cooperation and a low level of integration into the global environment.

3. At present, the role of education in the development of human capital is not limited to a preparatory stage for the professional activities and is becoming one of the leading factors of its reproduction and active dynamics. The continuous nature of the educational process allows for the development of the human abilities during all life,

discloses creative and intellectual potential and ensures the stability of formed competencies. A comparison of the proportion of people enrolled in educational institutions of different age groups (enrolment rates in education, by the age groups), can identify the following. In Russia, at the age of 15-19 years, participation in education amounts 83%. This level corresponds to the average value for OECD countries. But the study of the age groups of 20-29 and 30-39 years allows to select a lower level of involvement of the population in the educational process, 21% and 4%, respectively. In OECD countries, the average value of the share of the persons included in the educational process, is 28% for the group of 20-29 years, and 6% for the group of 30-39 years. This fact can be explained by the unwillingness of universities to offer competitive and quality programs for these populations.

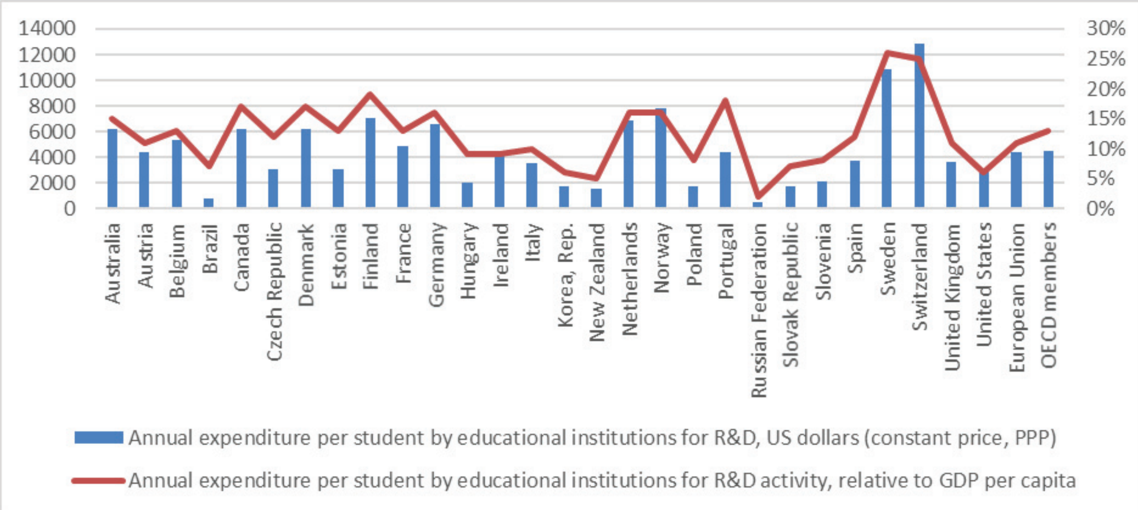

Fig. 1. Annual expenditure per student by educational institutions for R&D, 2011

The analysis suggests that higher education is contrary to the global educational trends, it is not consistent with the priorities of socio-economic development in Russia at the present stage, and also it limits the country's ability to build competitive innovation economy model. In recent years, the system of higher education in Russia is living in constant change. The speed of that change is so high that the error of choice of the wrong reforms' direction is commonplace. It is evidenced by the significant volatility of regulating parameters and by the incessant change of educational standards. The lack of clear guidelines of the reforms leads to a colossal amount of internal contradictions, to the frankly appearance of conflicting initiatives. Several authors have noted a tendency to curtail dialogue between the government and experts, which leads to the separation of the reform of the real needs of society. Under these circumstances, there is the need for speedy transformation of the higher education system. In our view, the formation of entrepreneurial universities, operating in close relationship with business and government should be the basis of this process.

Currently, Russia's regions are facing daunting but necessary task. It is increasing the competitiveness of the regional economies through the promotion of the territories innovative development. High efficiency and effectiveness of cluster policy in the leading countries of the world has led to the advancement of innovative regional clusters' development initiatives in the regions of Russia. Ministry of Economic Development held a competitive selection of pilot development programs. The following groups (blocks) of criteria have been taken into account as part of the competitive selection:

- scientific, technological and educational potential of the cluster;
- production potential of the cluster;
- quality of life and development of transport, energy, housing and engineering infrastructure of the territory;
- level of cluster's organizational development.

As a result of the selection of 94 proposals within the pilot program 25 regional clusters from 19 regions of

Russia were selected.

Studying the experience of innovative development of the United States and Western Europe shows that the leading actors of the "triple helix" were corporate giants for a long time, but in the last decade high-tech clusters tend to occur near the leading universities that engage fundamental and applied research, closely interact with industry and implement the knowledge into practice.

Given this trend, we analyzed the selected pilot programs of the innovation clusters' development in Russia for qualitative characteristics of "anchor" universities. The rating of Russian universities, compiled annually by the agency "Expert RA» (2014) has been used for these purposes. Integral evaluation of universities is based on the analysis of statistics and survey results of the following target groups: students and graduates, the representatives of the academic and scientific communities, the representatives of companies-employers. The final index consists of the following integral factors: conditions for quality education, the level of graduates' demand by employers, the level of the university research activity. To determine the quality of "anchor" universities in the selected innovative regional clusters, we used two integral factors included in the rating: "quality of education" and "the level of research activity." To assess the degree of influence of the universities' quality on the areas' innovative development we have identified two groups of regions that are areas of pilot clusters' placement (Table 2).

Table 2. Typology of the regions in terms of concentration of clusters with strong / weak "anchor" institutions of higher education

Regions which are concentrated by clusters with strong "anchor" institutions of higher education	Regions which are concentrated by clusters with weak "anchor" institutions of higher education
Krasnoyarsk region, Moscow, Moscow region, Novosibirsk region, Nizhny Novgorod region, Samara region, St. Petersburg, Sverdlovsk region, Tatarstan republic, Tomsk region	Altay region, Arkhangelsk region, Kaluga region, Kemerovo region, Perm region, Bashkortostan republic, Mordovia republic, Ulyanovsk region, Khabarovsk region

The crucial direction of the research is the evaluation of the innovative factors influence on the detected regions' social and economic development. For this purpose, the econometric evaluation of correlation of region's innovative development and GRP per capita has been held. The evaluation was based on the annual data of the Federal Service of Statistics for the period from 2010 to 2013. The following covariates were used:

- Internal costs on the scientific researches and development in % to GRP;
- Costs on the technological innovations in % to GRP;
- Volume of the innovative goods, operations and services in % to GRP;
- Staff quantity that is busy with scientific researches and elaborations per 10000 EAP;
- Quantity of the researchers with scientific degrees per 10000 EAP;
- Number of graduate and doctoral students per 10000 EAP;
- Coefficient of inventive activity;
- Number of the created advanced manufacturing sciences per 10000 EAP;
- Number of the used advanced manufacturing sciences per 10000 EAP;
- Ratios of the patent applications arrivals to the number of researchers.

The choice of these exact indicators was made due to the availability of statistical information, its comparability and the requirements of representativeness of a sample.

As a result of the correlation matrix between the variables, a strong correlation between internal costs on the scientific researches and development and staff quantity that is busy with scientific researches and elaborations was found. This relationship suggests that the bulk of the R&D costs goes to salaries of personnel involved in the research. It says that it is not the result of the research activity that is being financed, but its process. According to the results of correlation analysis the indicator "internal costs on the scientific researches and development in % to GRP " was excluded from the model.

The study provided the estimates of the impact of the selected explanatory variables on the GRP per capita. The resulting estimates were tested for econometric correctness, as the result, the models with the best quality characteristics were selected. The choice of models was carried out between the pass-through regression, regression with fixed individual effects and regression with random individual effects by the Wald, Broysh-Pagan and Hausman test (Table. 3).

Table. 3. The results of evaluation of the correlation between region's innovative development and GRP per capita (regions are in terms of concentration of clusters with strong / weak "anchor" institutions of higher education)

Regressors	Dependent variable - GDP per capita
	Model «within» with the random effects
Costs on the technological innovations in % to GRP	
Volume of the innovative goods, operations and services in % to GRP	
Staff quantity that is busy with scientific researches and elaborations per 10000 EAP	
Quantity of the researchers with scientific degrees per 10000 EAP	
Number of graduate and doctoral students per 10000 EAP	
Coefficient of inventive activity	61227,4***(19532,8)
Number of the created advanced manufacturing sciences per 10000 EAP	2,25***(752650)
Number of the used advanced manufacturing sciences per 10000 EAP	
Ratios of the patent applications arrivals to the number of researchers	
Constant	230936*** (59068,2)
Number of observations	48
Number of regions	16
R-squared	0,97

Notes:
*** - Significant at the 1% level.
Figures in parentheses are standard errors.

The findings suggest of a few innovation development indicators' influence the region's socio-economic development (regions are in terms of concentration of clusters with strong / weak "anchor" institutions of higher education). Significant figures are "coefficient of inventive activity", "number of the created advanced manufacturing sciences per 10000 EAP". Besides, the results of the research demonstrate the absence of the significant influence of the indices which characterize the process of innovations' implementation. It is worth noting that the most appropriate regression model is the model with random effects, which is used in the event when the choice of objects is carried out randomly from a large general population of elements and the random effect is not correlated with the regressors. Thus, the individual differences are random in the submitted sample of regions. Therefore, it becomes necessary to assess the impact of innovation on the socio-economic development of the regions where the anchor of innovative regional clusters' formation is a strong university (Table. 4).

Analysis of the results for the group of regions in terms of concentration of clusters with strong "anchor" institutions of higher education leads to the conclusion that almost all the covariates have a significant impact on the index of GDP per capita. This confirms the above conclusion that the essential element of the innovation system is the presence of strong universities that are interacting with the business, generating and implementing innovations. Thus, the necessary trend of innovative development should be the concentration of the innovation processes' all participants around the core which is the university. This model of innovative development allows innovations to be the engine of socio-economic development of regions.

It is worth noting the negative impact's presence of indicators "Number of graduate and doctoral students per 10000 EAP" and "ratios of the patent applications arrivals to the number of researchers." The situation with the number of graduate and doctoral students can be explained by the inefficiency of the Russian graduate school, which is associated with relatively low levels of academic requirements at all stages of the work evaluation, with the time of studying at a technical graduate (three years are not enough), low monthly allowance (monthly allowance in Russia in 50 times less than in the US or in the countries of the western Europe) that force graduate students to work and deal with a thesis residually. These factors certainly affect the relatively low quality of dissertations. The negative impact of indicator "ratios of the patent applications arrivals to the number of researchers" on the GDP per capita in the region proves the weak propensity to implant innovations in production.

Table. 4. Evaluation results of the correlation between region's innovative development and GRP per capita
(regions are in terms of concentration of clusters with strong "anchor" institutions of higher education)

Regressors	Dependent variable - GDP per capita
	Model «within» with the random effects
Costs on the technological innovations in % to GRP	4,17***(602670)
Volume of the innovative goods, operations and services in % to GRP	
Staff quantity that is busy with scientific researches and elaborations per 10000 EAP	12568,6***(2967,12)
Quantity of the researchers with scientific degrees per 10000 EAP	332440***(58821,6)
Number of graduate and doctoral students per 10000 EAP	-216516***(48034,3)

Coefficient of inventive activity	50597,3***(4908,53)
Number of the created advanced manufacturing sciences per 10000 EAP	3,39***(599116)
Number of the used advanced manufacturing sciences per 10000 EAP	47876,7***(10109,1)
Ratios of the patent applications` arrivals to the number of researchers	-368757***(74554,7)
Constant	417443*** (59068,2)
Number of observations	27
Number of regions	9
R-squared	0,96

Notes:
*** - Significant at the 1% level.
Figures in parentheses are standard errors.

4. Conclusion

Tyumen region ambitiously sets targets for the formation of innovation clusters. Great potential is associated with the development of the circumpolar region. Arctic projects should create a powerful momentum of innovation in the whole range of areas of science and technology. Obviously, this process involves changing the role of the university. Model "triple helix" combines innovative efforts of universities, business and government with the central role of the entrepreneurial university. Formation of this type of university requires a focus on three main areas.

Firstly, modernization of the students’ preparation process in universities with an emphasis on the formation of the systematic business competence of entrepreneurial vision and action. It is necessary to train professionals with the knowledge, skills and competence that allow to professionally analyze and to correctly assess the practical situations and to successfully solve the real problems of the enterprises and organizations’ modern business in the Tyumen region, Russia and in any developed country in the world.

Secondly, formation and development of universities’ innovation infrastructure with an emphasis on creating an conducive environment to the ideas’ exchange, to the development of adequate projects and business plans, to build a team among students, scholars, teachers, university staff and university partners.

Thirdly, formation and development of the university’s small innovative firms (start-ups), not only as the key actors of R&D commercialization, but also as objects of monitoring and research of innovative processes and platforms of innovative practices for students, graduate students, university faculty. In this regard, it is necessary to practically implement the following principles of the learning process.

1. Gradual formation of appropriate skills and competencies at all stages of student`s learning from solving educational problems to training that is based on the solution of real industrial and scientific problems within implementation of specific projects.

2. An integrated approach to the development of skills and competencies, involving intersubject and interdisciplinary interaction of students, teachers and scientists.

3. Formation of these skills and competencies on a continuous basis by means of:

- creation of organizational structures, platforms, laboratories, engineering workshops, contributing to the implementation of activities to build these skills and competencies;
- including the ways of their formation (design session, analytical session, organizational activity games, workshops) into the educational programs and planning, along with traditional academic work.

In addition, the new configuration of the innovation space, represented by the government, business and "science education", based on the stable relationships of key actors dominates. However, formation of such a configuration is not possible without balanced, coherent strategies that implement the universities and regional authorities. Creation of innovative regional clusters is a "common cause" which requires partnerships of mutual responsibility between major stakeholders and provides a favorable environment for the formation of regional innovation ecosystem.

Acknowledgements

The article is prepared on the basis of the research carried out with the financial support of the Russian Humanitarian Science Foundation grant (project №15-32-01350) “Innovative development of the Tyumen region’s circumpolar area: the possibility of localization and the effects of inter-regional cooperation”.

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